

## LAMINATION FOR SPECIALTY MEAT PACKAGING

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BACKGROUND OF THE INVENTIONFIELD OF THE INVENTION

The invention relates to packaging films. More particularly, the invention pertains case ready packaging films having good antifog performance that are  
10 suitable for use in meat packaging.

DESCRIPTION OF THE RELATED ART

Containers have long been used to store perishable foods, such as meats, fruits and vegetables, prior to sale in the marketplace to consumers. Maximizing the  
15 time in which the food remains preserved in the containers minimizes the amount of spoilage.

The environment around which the food is preserved is an important factor in the preservation process. It is important that the food is maintained at an  
20 adequate temperature, while also controlling the molecular and chemical content of the gases surrounding the food. By providing an appropriate gas content to the environment surrounding the food, the food can be better preserved when maintained at the proper temperature or even when it is exposed to variations in temperature. This gives the food producer some  
25 assurance that the food will be in an acceptable condition when it reaches the consumer. Preferred modified atmosphere packaging systems for foods, including raw meats, exposes these foods to extremely low levels of oxygen because it is well known that the freshness of meat can be preserved longer under anaerobic conditions than under aerobic conditions. Maintaining low

levels of oxygen minimizes the growth and multiplication of aerobic bacteria. Additionally, modified atmosphere packaging can involve high levels of oxygen, e.g. 80%, combined with nitrogen and/or carbon dioxide. The gases in these combinations do not favor bacterial growth but allow the raw meat to  
5 maintain a preferred red color that is acceptable to the consumer.

It is also important that the packaging exhibit good resistance to the formation of condensation inside the package on a surface of the film. This is known in the art as an antifog property. Multilayered films for modified atmosphere  
10 packaging having such antifog properties are well known and are commonly used when packaging food products having a high moisture content, such as fresh meats, and when it is important for the product to be clearly visible to the consumer. For example, U.S. patent 5,766,772 describes multi-layer heat-shrinkable films endowed with antifog properties having a different structure  
15 from this invention.

To produce a film exhibiting this antifog property, an antifog component is typically blended with or coated onto a sealant film such as a polyethylene film. This antifog-polyethylene component then forms a part of a multilayered  
20 packaging film, such as a nylon packaging film, that may also incorporate an oxygen barrier polymer layer such as ethylene vinyl alcohol. However, one significant problem associated with such known multilayered films having this antifog component is that the antifog component tends to be drawn toward polar materials, such as nylon, and away from the non-polar polyethylene.  
25 This is particularly a problem when the film is rolled up after manufacture such that the antifog layer or antifog containing polyethylene layer is brought into direct contact with an adjacent nylon layer. This causes the antifog component to migrate out of its existing polyethylene layer and into the nylon layer, compromising the performance of the nylon layer as well as degrading

the antifog property of the film. Therefore, it would be desirable to have a multilayered packaging film having good antifog performance and having an antifog component which does not migrate into adjacent nylon layers when stored. The present invention provides such a solution to this need.

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### SUMMARY OF THE INVENTION

The invention provides a multilayered film comprising:

- a) a nylon film having first and second surfaces;
- b) a silicone oil on the first surface of the nylon film; and
- 10 c) a sealant film on the second surface of the nylon film, which sealant film comprises at least one polyethylene layer, which at least one polyethylene layer either contains an antifog composition, or has an antifog composition coated on a surface thereof.

15 The invention also provides a multilayered film comprising:

- a) a nylon film comprising:
  - i. a first nylon layer, which first nylon layer has first and second surfaces;
  - ii. an ethylene vinyl alcohol layer, the ethylene vinyl alcohol layer having first and second surfaces and which is positioned such that the first surface of the ethylene vinyl alcohol layer is in contact with the first surface of the first nylon layer;
  - 20 iii. a second nylon layer, which second nylon layer has first and second surfaces, and which is positioned such that the first surface of the second nylon layer is in contact with the second surface of the ethylene vinyl alcohol layer;
- 25 b) a silicone oil on the second surface of the second nylon film; and
- c) a sealant film on the second surface of the first nylon layer, which sealant film comprises at least one polyethylene layer, which at least one polyethylene

layer either contains an antifog composition, or has an antifog composition coated on a surface thereof.

The invention further provides a multilayered film comprising:

- 5 a) a nylon film having first and second surfaces which comprises a layer of nylon 6, nylon 66, nylon 6/6,6 or a combination thereof;
  - b) a silicone oil on the first surface of the nylon film;
  - c) a sealant film on second surface of the nylon film, which sealant film comprises:
    - 10 i. a polyethylene layer having first and second surfaces, which polyethylene layer either contains an antifog composition, or has an antifog composition coated on the first surface thereof;
    - ii. a first nylon layer on the second surface of the polyethylene layer;
    - iii. an optional adhesive tie layer between said polyethylene layer and  
15 said first nylon layer, which optional adhesive tie layer attaches the first nylon layer to the polyethylene layer;
    - iv. an ethylene vinyl alcohol layer on the first nylon layer; and
    - v. a second nylon layer on the ethylene vinyl alcohol layer.
- 20 The invention still further provides a process for forming a multilayered film comprising:
- a) combining a nylon component with a silicone oil component to form a nylon blend;
  - b) forming a nylon film having first and second surfaces from the nylon blend,  
25 which silicone oil component is positioned at the surface of the nylon film;
  - c) coextruding a sealant film onto the second surface of the nylon film, which sealant film comprises a polyethylene layer, which polyethylene layer either contains an antifog composition, or has an antifog composition coated on a surface thereof.

The invention also provides a process for forming a multilayered film comprising:

- a) forming a nylon film having first and second surfaces;
- 5 b) coating a silicone oil onto the first surface of the nylon film;
- c) attaching a sealant film onto the second surface of the nylon film, which sealant film comprises at least one polyethylene layer, which at least one polyethylene layer either contains an antifog composition, or has an antifog composition coated on a surface thereof.

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Also provided is a food package which comprises a container having an open portion and a multilayered film sealing the open portion, which multilayered film comprises:

- a) a nylon film having first and second surfaces;
- 15 b) a silicone oil on the first surface of the nylon film; and
- c) a sealant film on the second surface of the nylon film, which sealant film comprises at least one polyethylene layer, which at least one polyethylene layer either contains an antifog composition, or has an antifog composition coated on a surface thereof.

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The invention also provides a multilayered film comprising:

- a) a nylon 666 film having first and second surfaces;
- b) a silicone oil on the first surface of the nylon film; and
- c) a sealant film on second surface of the nylon film, which sealant film
- 25 comprises:
  - i. a polyethylene layer having first and second surfaces, which polyethylene layer either contains an antifog composition, or has an antifog composition coated on the first surface thereof;
  - ii. a first nylon 6 layer on the second surface of the polyethylene layer,

- which first nylon 6 layer has a silicone oil on a surface thereof;
- iii. an adhesive tie layer between said polyethylene layer and said first nylon 6 layer, which adhesive tie layer attaches the first nylon 6 layer to the polyethylene layer;
- 5 iv. an ethylene vinyl alcohol layer on the first nylon 6 layer; and
- v. a second nylon 6 layer on the ethylene vinyl alcohol layer, which second nylon 6 layer has a silicone oil on a surface thereof;
- and wherein the nylon 666 film is attached to the second nylon 6 layer via an intermediate adhesive layer.

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The invention therefore provides a desirable multilayered packaging film having good antifog performance and having an antifog component which does not migrate into adjacent nylon layers when stored.

15 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention provides a multilayered packaging film having good antifog properties wherein the antifog composition does not migrate into adjacent polar film layers. In the production of a multilayered film according to the invention, a nylon film having first and second surfaces is positioned on a

20 surface of a sealant film, either directly on the surface of the nylon film or via an intermediate adhesive layer. On the other surface of the nylon film opposite the sealant film is a layer of a silicone oil. An antifog composition is contained within at least part of the sealant film or coated on a surface of the sealant film that is opposite to the nylon film, i.e. a surface different than the

25 surface to which the nylon film is attached. This film exhibits good, permanent antifog properties and avoids migration of the antifog composition out of the sealant film.

Nylons are conventionally used in the art of multilayered packaging films. Suitable nylons within the scope of the invention non-exclusively include homopolymers or copolymers selected from aliphatic polyamides and aliphatic/aromatic polyamides having a molecular weight of from about  
5 10,000 to about 100,000. General procedures useful for the preparation of polyamides are well known to the art. Such include the reaction products of diacids with diamines. Useful diacids for making polyamides include dicarboxylic acids which are represented by the general formula



wherein Z is representative of a divalent aliphatic radical containing at least 2 carbon atoms, such as adipic acid, sebacic acid, octadecanedioic acid, pimelic acid, suberic acid, azelaic acid, dodecanedioic acid, and glutaric acid. The  
15 dicarboxylic acids may be aliphatic acids, or aromatic acids such as isophthalic acid and terephthalic acid. Suitable diamines for making polyamides include those having the formula



wherein n has an integer value of 1-16, and includes such compounds as trimethylenediamine, tetramethylenediamine, pentamethylenediamine, hexamethylenediamine, octamethylenediamine, decamethylenediamine, dodecamethylenediamine, hexadecamethylenediamine, aromatic diamines  
25 such as p-phenylenediamine, 4,4'-diaminodiphenyl ether, 4,4'-diaminodiphenyl sulfone, 4,4'-diaminodiphenylmethane, alkylated diamines such as 2,2-dimethylpentamethylenediamine, 2,2,4-trimethylhexamethylenediamine, and 2,4,4 trimethylpentamethylenediamine, as well as cycloaliphatic diamines, such as diaminodicyclohexylmethane, and other compounds. Other useful

diamines include heptamethylenediamine, nonamethylenediamine, and the like.

Useful polyamide homopolymers include poly(4-aminobutyric acid) (nylon 4),  
5 poly(6-aminohexanoic acid) (nylon 6, also known as poly(caprolactam)),  
poly(7-aminooctanoic acid) (nylon 7), poly(8-aminooctanoic acid)(nylon 8),  
poly(9-aminononanoic acid) (nylon 9), poly(10-aminodecanoic acid) (nylon  
10), poly(11-aminoundecanoic acid) (nylon 11), poly(12-aminododecanoic  
acid) (nylon 12), nylon 4,6, poly(hexamethylene adipamide) (nylon 6,6),  
10 poly(hexamethylene sebacamide) (nylon 6,10), poly(heptamethylene  
pimelamide) (nylon 7,7), poly(octamethylene suberamide) (nylon 8,8),  
poly(hexamethylene azelamide) (nylon 6,9), poly(nonamethylene azelamide)  
(nylon 9,9), poly(decamethylene azelamide) (nylon 10,9),  
poly(tetramethylenediamine-co-oxalic acid) (nylon 4,2), the polyamide of n-  
15 dodecanedioic acid and hexamethylenediamine (nylon 6,12), the polyamide of  
dodecamethylenediamine and n-dodecanedioic acid (nylon 12,12) and the  
like. Useful aliphatic polyamide copolymers include  
caprolactam/hexamethylene adipamide copolymer (nylon 6,6/6),  
hexamethylene adipamide/caprolactam copolymer (nylon 6/6,6), trimethylene  
20 adipamide/hexamethylene azelamide copolymer (nylon trimethyl 6,2/6,2),  
hexamethylene adipamide-hexamethylene-azelamide caprolactam copolymer  
(nylon 6,6/6,9/6) and the like. Also included are other nylons which are not  
particularly delineated here. Of these polyamides, preferred polyamides  
include nylon 6, nylon 6,6, nylon 6/6,6 as well as mixtures of the same. The  
25 most preferred polyamide is nylon 6.

Aliphatic polyamides used in the practice of this invention may be obtained  
from commercial sources or prepared in accordance with known preparatory



techniques. For example, poly(caprolactam) can be obtained from Honeywell International Inc., Morristown, New Jersey under the trademark CAPRON®.

Exemplary of aliphatic/aromatic polyamides include

- 5 poly(tetramethylenediamine-co-isophthalic acid) (nylon 4,I),  
polyhexamethylene isophthalamide (nylon 6,I), hexamethylene  
adipamide/hexamethylene-isophthalamide (nylon 6,6/6I), hexamethylene  
adipamide/hexamethylene-terephthalamide (nylon 6,6/6T), poly (2,2,2-  
trimethyl hexamethylene terephthalamide), poly(m-xylylene adipamide)  
10 (MXD6), poly(p-xylylene adipamide), poly(hexamethylene terephthalamide),  
poly(dodecamethylene terephthalamide), polyamide 6T/6I, polyamide  
6/MXDT/I, polyamide MXDI, and the like. Blends of two or more  
aliphatic/aromatic polyamides can also be used. Aliphatic/aromatic polyamides  
can be prepared by known preparative techniques or can be obtained from  
15 commercial sources. Other suitable polyamides are described in U.S. patents  
4,826,955 and 5,541,267, which are incorporated herein by reference.

- Positioned on a first surface of the nylon film is a silicone oil lubricant. This  
silicone oil may generally comprise any surface active lubricant which is  
20 preferably comprised of a polydimethylsiloxane material. The preferred  
silicone oils suitable for use in the present invention are food grade silicone  
oils. These are preferably a clear fluid, with a wide range of viscosities,  
ranging from about 0.65 cSt up to about 100,000 cSt., are essentially nontoxic  
and present a low environmental hazard. Additionally, these are very  
25 thermally stable materials that have low surface tension and a minimal  
viscosity variation of from about -40 °C to about 204°C. Silicone oils are also  
available in industrial and medical grades.

The food grade polydimethylsiloxane silicone oils are preferably 100% active

silicone fluids that are inert, nontoxic and non-carbonizing. They generally have number average molecular weights ranging from about 7,500 to about 106,000. In the preferred embodiment of the invention, the food grade silicone oils used have viscosities ranging from about 50 cSt to about 1,000 cSt.

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In order for the silicone oil to function as desired, it is necessary that it be present at an outer surface of the nylon film. Therefore, when the multilayered film of the invention is produced and rolled up for storage, the silicone oil is in contact with the antifog composition on the outer surface of the sealant film.

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This may be accomplished using techniques that are well known in the art. For example, silicone oil may be coated onto the outer surface of the nylon film. Suitable coating methods include dip coating, meniscus coating, roller coating, doctor blade coating, and the like which are well known in the art. In an alternate method, the silicone oil component may be blended together with the nylon component to form a nylon blend, prior to forming the nylon into a film, via well known extrusion techniques described in detail below. In this embodiment, once the nylon film is formed from the blend, the silicone oil effectively blooms to the surface of the film.

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Positioned on a second surface of the nylon film is a high clarity, highly shrinkable, heat sealable polyolefin sealant film. The sealant film is preferably comprised of polyethylene, and has an antifog composition that is either combined with the polyethylene or coated on a surface of the sealant film opposite the nylon film. Non-limiting examples of suitable polyethylenes are low density polyethylene (LDPE), linear low density polyethylene (LLDPE), linear medium density polyethylene (LMDPE), linear very-low density polyethylene (VLDPE), linear ultra-low density polyethylene (ULDPE), metallocene linear low density polyethylene (m-LLDPE) high density polyethylene (HDPE). Of these, the most preferred is a low density

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polyethylene, particularly linear low density polyethylene.

- The antifog composition prevents condensation on the film when used to package products such as fresh meats, vegetables, etc. Non-limiting examples of antifog compositions are glycerol monoesters of a saturated or unsaturated fatty acid having from about 8 to about 20 carbon atoms, glycerol diesters of a saturated or unsaturated fatty acid having from about 8 to about 20 carbon atoms and ionic surfactants having phosphate, sulfate or quaternary amine functional end groups. Also suitable as antifog compositions are surfactants including anionic, cationic, nonionic and amphoteric surfactants. Suitable ionic surfactants have phosphate, sulfate or quaternary amine functional end groups. Other antifog compositions include sorbitan esters of aliphatic carboxylic acids, glycerol esters of aliphatic carboxylic acids, esters of other polyhydric alcohols with aliphatic carboxylic acids, polyoxyethylene compounds, such as the polyoxyethylene sorbitan esters of aliphatic carboxylic acids and polyoxyethylene ethers of higher aliphatic alcohols. Preferred antifog compositions are glycerol monooleate, glycerol monostearate, sorbitan esters and blends thereof. When the antifog composition is incorporated into the sealant film, it is blended into the polyethylene composition preferably in an amount of from about 0.1 weight percent to about 5 weight percent. When the antifog composition is coated on the sealant film it is preferably applied at a coating weight of from about 0.2 to about 0.6 g/m<sup>2</sup>. Suitable antifog compositions are described, for example, in U.S. patent 5,766,772.
- 25 In an alternate embodiment of the invention, the sealant film may be comprised of a combination of various individual layers in addition to polyethylene. For example, the sealant film may comprise a multilayered structure comprising a polyethylene layer having first and second surfaces which either contains an antifog composition, or has an antifog composition

coated on the first surface thereof, a first nylon layer on the second surface of the polyethylene layer, and further including an optional adhesive tie layer between said polyethylene layer and said first nylon layer to adhere the two layers together, an ethylene vinyl alcohol layer on the first nylon layer, and a  
5 second nylon layer on the ethylene vinyl alcohol layer. Additionally, the sealant film may comprise a first polyethylene layer, a first adhesive tie layer on the first polyethylene layer, an ethylene vinyl alcohol layer on the first adhesive tie layer, a second adhesive tie layer on the ethylene vinyl alcohol layer, and a second polyethylene layer on the second adhesive tie layer. Each  
10 of the first and second nylon layers may be the same or different and may comprise any of the polyamide materials described above. Additionally, each of said first and second polyethylene layers may be the same or different and may comprise any of the polyamide materials described above.

15 Ethylene vinyl alcohol compounds are well known in the art and readily commercially available. Copolymers of ethylene and vinyl alcohol suitable for use in the present invention can be prepared, for example, by the methods disclosed in U.S. patents 3,510,464; 3,560,461; 3,847,845; 3,595,740 and 3,585,177. The ethylene vinyl alcohol copolymer can be a hydrolyzed  
20 ethylene vinyl acetate copolymer. The degree of hydrolysis can range from about 85% to about 99.5%. The ethylene vinyl alcohol copolymer preferably contains from about 15 to about 65 mol percent ethylene and more preferably about 25 to about 50 mol percent ethylene. Copolymers of lower than 15 mol percent ethylene tend to be difficult to extrude while those above 65 mol  
25 percent ethylene have reduced oxygen barrier performance. The term "ethylene/vinyl alcohol copolymer" or "EVOH" is intended to comprise also the hydrolyzed or saponified ethylene/vinyl acetate copolymers and refers to a vinyl alcohol copolymer having an ethylene comonomer, which may be

obtained, for example, by the hydrolysis of an ethylene/vinyl acetate copolymer or by chemical reaction of ethylene monomers with vinyl alcohol.

Suitable adhesive materials include polyurethanes, epoxies, polyesters,  
5 acrylics, anhydride modified polyolefin and blends thereof. Modified polyolefin compositions have at least one functional moiety preferably selected from the group consisting of unsaturated polycarboxylic acids and anhydrides thereof. Such unsaturated carboxylic acid and anhydrides include maleic acid and anhydride, fumaric acid and anhydride, crotonic acid and anhydride,  
10 citraconic acid and anhydride, itaconic acid and anhydride the like. The adhesive layer may also optionally comprise a colorant, an ultraviolet light absorber or both. The adhesive layer may be applied directly onto either of the adjacent layers by any appropriate means in the art, such as by coating. Suitable coating techniques are described above.

15 Each of the nylon film, sealant film or any of the individual layers described herein may optionally also include one or more conventional additives whose uses are well known to those skilled in the art. The use of such additives may be desirable in enhancing the processing of the compositions as well as  
20 improving the products or articles formed therefrom. Examples of such include: oxidative and thermal stabilizers, lubricants, release agents, flame-retarding agents, oxidation inhibitors, oxidation scavengers, dyes, pigments and other coloring agents, ultraviolet light absorbers and stabilizers, organic or inorganic fillers including particulate and fibrous fillers, reinforcing agents,  
25 nucleators, plasticizers, as well as other conventional additives known to the art. Such may be used in amounts, for example, of up to about 10 % by weight of the overall composition. Representative ultraviolet light stabilizers include various substituted resorcinols, salicylates, benzotriazole, benzophenones, and the like. Suitable lubricants and release agents include stearic acid, stearyl

alcohol, and stearamides. Exemplary flame-retardants include organic halogenated compounds, including decabromodiphenyl ether and the like as well as inorganic compounds. Suitable coloring agents including dyes and pigments include cadmium sulfide, cadmium selenide, titanium dioxide, phthalocyanines, ultramarine blue, nigrosine, carbon black and the like. Representative oxidative and thermal stabilizers include the Period Table of Element's Group I metal halides, such as sodium halides, potassium halides, lithium halides; as well as cuprous halides; and further, chlorides, bromides, iodides. Also, hindered phenols, hydroquinones, aromatic amines as well as substituted members of those above mentioned groups and combinations thereof. Exemplary plasticizers include lactams such as caprolactam and lauryl lactam, sulfonamides such as o,p-toluenesulfonamide and N-ethyl, N-butyl benzylsulfonamide, and combinations of any of the above, as well as other plasticizers known to the art.

Each of the layers may be joined together by coextrusion. In the coextrusion process, for example, the polymeric material for the individual layers are fed into infeed hoppers of a like number of extruders, each extruder handling the material for one or more of the layers. In the preferred embodiment of the invention, this technique is used to form a blend of the nylon material and the silicone oil. Preferably, the silicone oil is added to the melted nylon at about 100 ppm to about 200 ppm, more preferably from about 125 ppm to about 175 ppm, and most preferably from about 140 ppm to about 160 ppm. The melted and plasticated streams from the individual extruders are fed into a single manifold co-extrusion die. While in the die, the layers are juxtaposed and combined, then emerge from the die as a single multiple layer film of polymeric material. After exiting the die, the film is cast onto a first controlled temperature casting roll, passes around the first roll, and then onto a second controlled temperature roll, which is normally cooler than the first roll. The

controlled temperature rolls largely control the rate of cooling of the film after it exits the die. Additional rolls may be employed. In another method, the film forming apparatus may be one which is referred to in the art as a blown film apparatus and includes a multi-manifold circular die head for bubble  
5 blown film through which the plasticized film composition is forced and formed into a film bubble which may ultimately be collapsed and formed into a film. Processes of coextrusion to form film and sheet laminates are generally known. Typical coextrusion techniques are described in U.S. patents 5,139,878 and 4,677,017.

10 Alternately the individual films may first be formed as separate layers and then laminated together under heat and pressure with or without intermediate adhesive layers. Lamination techniques are well known in the art. Typically, laminating is done by positioning the individual layers on one another under  
15 conditions of sufficient heat and pressure to cause the layers to combine into a unitary film. Typically the nylon film and the antifog composition containing sealant film will be positioned on one another such that each of the antifog composition layer and the silicone oil layer are facing outward, and the combination is passed through the nip of a pair of heated laminating rollers by  
20 techniques well known in the art. Lamination heating may be done at temperatures ranging from about 120°C to about 175°C, preferably from about 150°C to about 175°C, at pressures ranging from about 5 psig (0.034 MPa) to about 100 psig (0.69 MPa), for from about 5 seconds to about 5 minutes, preferably from about 30 seconds to about 1 minute.

25 Each of the various multilayered structures of the invention may be formed either by lamination or by coextrusion of the individual layers. For example, when the sealant film comprises the multilayered structure described above, it

is preferred that the individual layers are laminated together. However, it is most preferred that the nylon film and its component layers be coextruded.

In one embodiment of the invention, the nylon film is oriented prior to being  
5 attached to the sealant film. For the purposes of the present invention the term draw ratio is an indication of the increase in the dimension in the direction of draw. Preferably, in the present invention the nylon film is drawn to a draw ratio of from 1.5:1 to 5:1 uniaxially in at least one direction, i.e. its longitudinal direction, its transverse direction or biaxially in each of its  
10 longitudinal and transverse directions. Preferably, the nylon film is simultaneously biaxially oriented, for example orienting a plasticized film in both the machine and transverse directions at the same. This results in dramatic improvements in clarity strength and toughness properties. Preferably, the nylon film is biaxially oriented and is not heat set so that it is  
15 shrinkable both in its transverse and longitudinal directions. Alternately, the nylon may be an unoriented cast nylon. It is also within the scope of the invention that the nylon film or individual nylon layers be subjected to a corona treatment in order to improve the adhesion to other layers. A corona treatment is a process in by which a layer of material is passed through a  
20 corona discharge station giving the surface of the layer a charge that improves its ability to bond to an adjacent layer. However, this step is not required. If conducted, it is preferably done immediately after extrusion of the layer or film.

25 Although each layer of the multilayer film structure may have a different thickness, the thickness of the nylon film is preferably from about 1  $\mu\text{m}$  to about 25  $\mu\text{m}$ , more preferably from about 3  $\mu\text{m}$  to about 8  $\mu\text{m}$ , and most preferably from about 4  $\mu\text{m}$  to about 6  $\mu\text{m}$ . The thickness of the silicone oil layer is preferably from about 1  $\mu\text{m}$  to about 25  $\mu\text{m}$ , more preferably from



about 2  $\mu\text{m}$  to about 8  $\mu\text{m}$  and most preferably from about 3  $\mu\text{m}$  to about 5  $\mu\text{m}$ . The thickness of the sealant film is preferably from about 1  $\mu\text{m}$  to about 50  $\mu\text{m}$ , more preferably from about 10  $\mu\text{m}$  to about 30  $\mu\text{m}$ , and most preferably from about 12  $\mu\text{m}$  to about 25  $\mu\text{m}$ . If a multicomponent sealant film is  
5 included rather than an individual antifog containing polyethylene layer, the thickness of that multicomponent sealant film is preferably within this range. While such thicknesses are preferred, it is to be understood that other film thicknesses may be produced to satisfy a particular need and yet fall within the scope of the present invention.

10 The oxygen transmission rate (OTR) of the multilayered film of the invention may be determined via the procedure of ASTM D-3985. In the preferred embodiment, the multilayered film according to this invention has an OTR of about 0.5 cc/100 in<sup>2</sup>/day or less, preferably from about 0.1 cc/100 in<sup>2</sup>/day or  
15 less and more preferably from about 0.05 cc/100 in<sup>2</sup>/day or less at 65% relative humidity at 20°C.

The multilayered film of the invention is preferably heat shrinkable, generally by an amount of from about 2% to about 30%, more preferably from  
20 about 10% to about 20 % in its length, or its width or each of its length and width. To provide a tightly adhering lid for a tray, for example, the film only need to exhibit shrinkage on the order of about 2 to about 3%. However, in order to have the film also form (unrestrained) about the side of the tray, higher shrinkage in the film is desirable.

25 The multilayered film may further have printed indicia on the nylon film. Since such printing is on an internal surface of the structure, it will not rub off when the surface is contacted. Optionally, the multilayered film may be uniaxially or biaxially oriented in a manner and in an amount indicated above

for the nylon film and is not heat set so that it is shrinkable both in its transverse and longitudinal directions. In this case the nylon film may or may not have been oriented already.

- 5 The film preferably has a puncture resistance of at least about 10 lbs. force as measured by ASTM F 1306, and preferably higher than 10 lbs. force. Preferably the film has a haze of about 4 % or less and a clarity of about 92% or higher as measured by ASTM D1003.
- 10 The multilayered film may be formed as a web and stored as a roll. It has been found that the unique structure of this inventive film is particularly effective in preventing the migration of the antifog material from the polyethylene of the sealant film to the nylon film when in roll form. More particularly, it has been unexpectedly found that the use of a silicone oil lubricant effectively blocks
- 15 the migration of the antifog. Therefore, the invention is useful for a wide variety of structures formed with a wide variety of materials, in order to insure excellent antifog performance.

- The multilayered film is useful for forming a food package including a
- 20 container, such as a tray, having an open portion and the multilayered film sealing the open portion. Such a structure is generally referred to a lidding or packaging film. Such containers are suitable for packaging a variety of raw meats such as beef, pork, poultry, and veal, among others. A packaged food may comprises the food package and a food product such as a meat in the food
- 25 package.

The container may have enclosed side walls, a floor and an top opening defining a central cavity wherein the open top optionally has a substantially flat peripheral rim. The multilayered film surrounds the container and is heat

shrunk and heat sealed to it such that the antifog composition is on the open portion (facing inward) and the nylon film is facing away from the open portion of the container. The container may comprise a material such as cardboard, paperboard, boardstock, a plastic and combinations thereof.

5 Preferred plastics include any one of several thermosetting or thermoplastic resins any of which are capable of sealing to the lidding material. Examples of materials include acrylonitrile, an acrylic polymer, polyethylene terephthalate (PET) or copolymers thereof, polyvinyl chloride, polycarbonate, polystyrene and polypropylene. In use the multilayered film is positioned around the open  
10 portion and is caused to shrink, e.g. by the application of heat, by a sufficient amount to seal the open portion of the container.

The invention further contemplates additional layers being attached to the multilayered film either before or after attaching the nylon film. For example,  
15 the nylon film of the invention may comprise a single nylon layer, or may also comprise additional layers. In particular, the nylon film may comprise a structure comprising a first nylon layer having first and second surfaces, an ethylene vinyl alcohol layer, the ethylene vinyl alcohol layer having first and second surfaces and which is positioned such that the first surface of the  
20 ethylene vinyl alcohol layer is in contact with the first surface of the first nylon layer, and a second nylon layer, which second nylon layer has first and second surfaces, and which is positioned such that the first surface of the second nylon layer is in contact with the second surface of the ethylene vinyl alcohol layer. In this embodiment, each of the layers are preferably attached by coextrusion,  
25 but may also be attached by lamination with or without an intermediate adhesive layer. Further, the desired thickness for a multilayered nylon film is preferably from about 1  $\mu\text{m}$  to about 50  $\mu\text{m}$ , more preferably from about 10  $\mu\text{m}$  to about 30  $\mu\text{m}$ , and most preferably from about 12  $\mu\text{m}$  to about 25  $\mu\text{m}$ .

It is also within the intended scope of the invention that any of the individual nylon layers of the invention, in addition to the nylon film, may have a silicone oil on a surface thereof. The silicone oil is preferably the same oil as is present on a surface of the nylon film, and may be coated onto a surface of the nylon layers or blended with the nylon prior to extrusion. For example, in one preferred embodiment of the invention, the multilayered film comprises a coextrusion of a nylon 666 film having a silicone oil on its surface, this nylon 666 film is then attached to a sealant film structure comprising a first nylon 6 layer having a silicone oil on a surface thereof, an ethylene vinyl alcohol layer attached to the first nylon 6 layer, a second nylon 6 layer having a silicone oil on a surface thereof attached to the ethylene vinyl alcohol layer, an adhesive tie layer on the second nylon 6 layer and a antifog containing polyethylene layer attached to the second nylon 6 layer via the adhesive tie layer. The invention, however, is not limited solely to the particular embodiments that are disclosed.

The following non-limiting examples serve to illustrate the invention.

### EXAMPLES

In each of the following examples, a monolayer film of Huntsman Linear Low Density Polyethylene (Rexcell L3103) containing 25% of an antifog masterbatch (1.25% active antifog agent) was laminated to a variety of different polyamide monolayer films. The lamination was done by pressing the films together at room temperature in a GBC3500 desktop laminator. This cold lamination simulates the contact that a polyamide film would have with the antifog containing film wound in a roll. After a given number of days, the polyethylene film was removed and sealed to a 5"x7" polyethylene tray containing a pad of tissue paper soaked with 30 mils of water as a substitute

for a piece of cut meat. The tray was placed inside a refrigerator and the extent of condensation buildup on the film surface was noted after a set period of time (5 hours). The degree of condensation and antifog performance rating is described in Table 1. A score of above 8 is acceptable. The results are

5 described in Table 2.

TABLE 1

Grade	Antifog Performance
0	Fine fog across entire surface. Difficult to view product
2	Small droplets ( 1 - 2 mm). Product somewhat obscured.
4	Medium droplets ( 2 – 4 mm).
6	Large drops ( > 4 mm).
8	Moisture visible but fairly uniform with some texture or large drops.
10	Indistinguishable from dry film over entire package.

10

TABLE 2

Polyamide Film	Containing Silicone Oil	Before Lamination (In Roll form for 0 days)	In Roll for 2 days	In Roll for 4 days	In Roll for 6 days
Nylon 6	No	8	6	5	4
Nylon 6	Yes	9	6	8	9
Nylon 666	Yes	8	7	9	9

15 The examples show the enhanced antifog performance after lamination and roll storage of the laminates using silicone oil additives.

While the present invention has been particularly shown and described with reference to preferred embodiments, it will be readily appreciated by those of ordinary skill in the art that various changes and modifications may be made without departing from the spirit and scope of the invention. It is intended that  
5 the claims be interpreted to cover the disclosed embodiment, those alternatives which have been discussed above and all equivalents thereto.